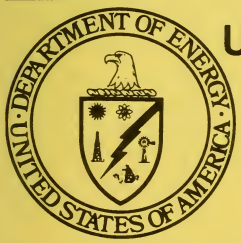
SOLAR/1058-79/05

Monthly Performance Report

BRAD POPKIN

MAY 1979



U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

MONTHLY PERFORMANCE REPORT

BRAD POPKIN

MAY 1979

I. SYSTEM DESCRIPTION

The Brad Popkin site is a single-family residence in Carrollton, Texas. The home has approximately 2300 square feet of conditioned space. Solar energy is used for space heating and preheating domestic hot water (DHW). The solar energy system has an array of seven flat-plate collectors with a gross area of 248 square feet. The array faces south at an angle of 46 degrees to the horizontal. Air is the transfer medium that delivers solar energy from the collector array to storage and to the space heating load. Solar energy is stored aboveground in two 144-cubic-foot bins, each containing 7 tons of rock. The bins are 12 feet high by 4 feet in diameter with 3-inch concrete walls and 4 inches of fiberglass insulation. City water is supplied, on demand, to a conventional 80-gallon DHW tank. When solar energy is insufficient to satisfy the space heating load, an electrical heating element in the air-handling unit provides auxiliary energy for space heating. Similarly, an electrical heating element in the DHW tank provides auxiliary energy for water heating. The system, shown schematically in Figure 1, has six modes of solar operation.

Mode 1 - Collector-to-Storage: This mode activates when temperature sensors detect a temperature difference of 40°F across the collector array. The collector loop fan turns on and pushes the heated air through rock storage.

Mode 2 - Collector-to-Space Heating - Solar Only: This mode activates when the collector loop fan is on and there is a demand for space heating and the temperature in the rock storage bins is equal to or greater than 90°F.

Mode 3 - Collector-to-Space Heating - Solar Plus Heat Strips: This mode activates when the collector loop fan is on and there is a demand for space heating and the temperature in the rock storage bins is greater than 70°F but less than 90°F.

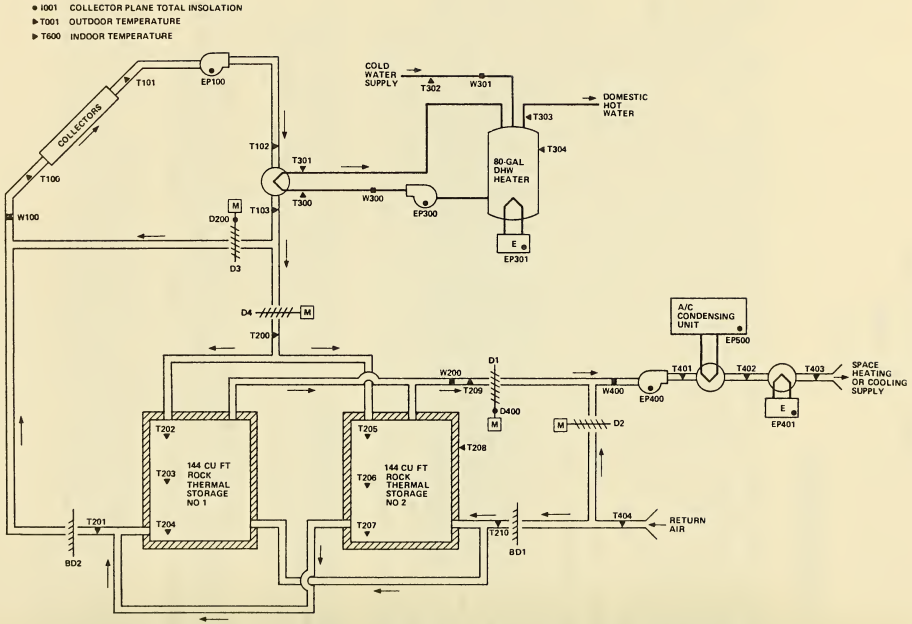


Figure 1 . BRAD POPKIN SOLAR ENERGY SYSTEM SCHEMATIC

Mode 4 - Storage-to-Space Heating - Solar Only: This mode activates when there is a demand for space heating and the temperature in the rock storage bins is equal to or greater than 90°F.

Mode 5 - Storage-to-Space Heating - Solar Plus Heat Strips: This mode activates when there is a demand for space heating and the temperature in the rock storage bins is greater than 70°F but less than 90°F.

Mode 6 - Space Heating - Heat Strips Only: This mode activates when there is a demand for space heating and the temperature in the rock storage bins is less than 70°F.

Mode 7 - Collector-to-DHW Preheat: This mode activates when the collector loop fan is on and the temperature difference across the heat exchanger unit (water side) is equal to or greater than 12°F. During summer operation, damper D4 closes and damper D2 opens, thus creating a closed loop for DHW preheat only.

II. PERFORMANCE EVALUATION

INTRODUCTION

The site was unoccupied in May and the solar energy system operated continuously during the month. Total solar energy collected was 1.7 million Btu and the total solar energy used was 0.15 million Btu or 8 percent of the collected energy. The change in stored energy was -0.08 million Btu and the total system losses amounted to 1.6 million Btu. Solar energy satisfied 9 percent of the DHW requirements and 11 percent of the space heating requirements. The solar energy system provided a net electrical savings of 0.016 million Btu.

WEATHER CONDITIONS

During the month, total incident solar energy on the collector array was 10.8 million Btu for a daily average of 1406 Btu per square foot. This was below the estimated average daily solar radiation for this geographical area during May of 1516 Btu per square foot for a south-facing plane with a tilt of 46 degrees to the horizontal. The average ambient temperature during May was 70°F as compared with the long-term average for May of 74°F. The number of heating degree-days for the month (based on a 65°F reference) was 32, as compared with the long-term average of zero. The number of cooling degree-days was 151, as compared with the average of 273.

THERMAL PERFORMANCE

System - During May the solar energy system performed somewhat poorer than expected. The expected performance was determined from a modified f-chart analysis using measured weather and subsystem loads as input. Solar energy used by the system was estimated by assuming that all energy collected would be applied to the load. Actual solar energy used was 0.15 million Btu versus an estimated 0.70 million Btu. System total solar fraction was 11 percent versus an estimated 100 percent.

Collector - The total incident solar radiation on the collector array for the month of May was 10.8 million Btu. During the period the collector loop was operating, the total insolation amounted to 5.9 million Btu. The total collected solar energy for the month of May was 1.7 million Btu, resulting in a collector array efficiency of 16 percent, based on total incident insolation. Solar energy delivered from the collector array to storage was 1.7 million Btu, while solar energy delivered from the collector array directly to the loads amounted to 0.15 million Btu. Because of its design and location, this solar energy site has the potential for storing more energy than is collected. This is because the entire solar energy system (except for the two rock storage bins) is located in the attic. Temperatures in the attic easily reach 125°F

during the day and sensor T200 has recorded 90°F at midnight. As in most air systems, when the collector loop blower (EP 100) goes off, there continues to be low-level air flow due to leakage, natural convection and dampers not fully closing. At this site, this low-level air flow is through the attic ducts, and continues to add solar energy to the rock storage bins after the collector loop blower has stopped. For May, the excess of stored energy plus energy directly to load over collected energy was 0.14 million Btu. This imbalance will be monitored in forthcoming months. Operating energy requird by the collector loop was 0.11 million Btu.

Storage - Solar energy delivered to storage was 1.7 million Btu. There was no energy delivered from storage to the space heating subsystem. Energy loss from storage was 1.8 million Btu. This loss represented 100 percent of the energy delivered to storage. The storage efficiency was a negative 4 percent: This is calculated as the ratio of the sum of the energy removed from storage and the change in stored energy, to the energy delivered to storage. The average storage temperature for the month was 89°F. A negative efficiency at this time of the year is consistent with the site design and operation. Damper D4 was closed on May 15 and prevented collected solar energy from reaching storage. This will allow the storage bins to cool and reach a minimum temperature level, until temperature buildup resumes in the fall heating season.

DHW Load - Since there was only a total of 3 gallons of DHW consumed during May, a meaningful analysis and discussion of this subsystem cannot be accomplished.

The preheat loop pump was replaced as scheduled by the grantee. The DHW subsystem consumed 0.15 million Btu of auxiliary electrical energy during May to maintain an average output temperature of 140°F.

Space Heating Load - The space heating subsystem consumed 0.053 million Btu of solar energy and 0.43 million Btu of auxiliary electrical energy to satisfy a

space heating load of 0.48 million Btu. The solar fraction of this load was 11 percent. The space heating subsystem consumed a total of 0.022 million Btu of operating energy, resulting in an electrical energy savings of 0.031 million Btu.

OBSERVATIONS

This site is now operating in summer status (i.e., damper D4 is closed) and the only solar mode is collector to DHW preheat. Therefore, site reporting will be minimal until space heating is again required.

ENERGY SAVINGS

The solar energy system provided a net electrical energy savings of 0.016 million Btu. The DHW subsystem provided an electrical energy savings of 0.093 million Btu, while the space heating subsystem contributed an electrical savings of 0.031 million Btu.

III. ACTION STATUS

No action is required at this time.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: BRAD POPKIN , CARROLLTON , TEXAS 75006 SOLAR/1024-79/05
REPORT PERIOD: MAY,1979

SITE/SYSTEM DESCRIPTION:
THE BRAD POPKIN SOLAR ENERGY SYSTEM PROVIDES SPACE HEATING AND DOMESTIC HOT WATER TO A SINGLE FAMILY DWELLING UNIT OF APPROX. 2300 SQ. FT. THE COLLECTOR UNIT CONSISTS OF FLAT PLATE AIR PANELS, MOUNTED DUE SOUTH AT A 46 DEGREE TILT, WITH AN OVERALL AREA OF 248 SQ. FT. THERMAL STORAGE CONSISTS OF TWO ROCK FILLED TANKS WITH A COMBINED CAPACITY OF 288 CU. FT. DOMESTIC HOT WATER IS PREHEATED BY CIRCULATING THROUGH A HEAT EXCHANGE COIL IN THE COLLECTOR LOOP. SPACE HEATING IS ACCOMPLISHED BY DRAWING SOLAR ENERGY DIRECTLY FROM THE COLLECTION CYCLE OR FROM STORAGE.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	10.809 MILLION BTU
	43584 BTU/SQ.FT.
COLLECTED SOLAR ENERGY	1.707 MILLION BTU
	6883 BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	70 DEGREES F
AVERAGE BUILDING TEMPERATURE	73 DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.01
ECSS OPERATING ENERGY	0.108 MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	0.137 MILLION BTU
TOTAL ENERGY CONSUMED	2.419 MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	0.001	0.477	0.000	0.479 MILLION BTU
SOLAR FRACTION	5	11	N.A.	11 PERCENT
SOLAR ENERGY USED	0.093	0.053	N.A.	0.146 MILLION BTU
OPERATING ENERGY	0.007	0.022	0.022	0.137 MILLION BTU
AUX. THERMAL ENERGY	0.150	0.425	0.000	0.575 MILLION BTU
AUX. ELECTRIC FUEL	0.150	0.425	0.000	0.575 MILLION BTU
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. MILLION BTU
ELECTRICAL SAVINGS	0.093	0.031	N.A.	0.016 MILLION BTU
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.202

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: BRAD POPKIN , CARROLLTON , TEXAS 75006 SOLAR/1024-79/05
REPORT PERIOD: MAY,1979

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GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	11.403 GIGA JOULES
	494945 KJ/SQ.M.
COLLECTED SOLAR ENERGY	1.801 GIGA JOULES
	78165 KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	21 DEGREES C
AVERAGE BUILDING TEMPERATURE	23 DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.01
ECSS OPERATING ENERGY	0.114 GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	0.145 GIGA JOULES
TOTAL ENERGY CONSUMED	2.552 GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	0.001	0.504	0.000	0.505 GIGA JOULES
SOLAR FRACTION	9	11	N.A.	11 PERCENT
SOLAR ENERGY USED	0.098	0.056	N.A.	0.154 GIGA JOULES
OPERATING ENERGY	0.008	0.023	0.023	0.145 GIGA JOULES
AUX. THERMAL ENG	0.158	0.448	0.000	0.606 GIGA JOULES
AUX. ELECTRIC FUEL	0.158	0.448	0.000	0.606 GIGA JOULES
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. GIGA JOULES
ELECTRICAL SAVINGS	0.098	0.033	N.A.	0.017 GIGA JOULES
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.202

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: BRAD POPKIN , CARROLLTON , TEXAS 75006 SOLAR/1024-79/05
REPORT PERIOD: MAY,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	0.285	66	0.000	N	0.004	N	0.000
2	0.109	71	0.000	C	0.000	O	0.000
3	0.001	66	C.CCO	T	0.000	T	0.000
4	0.091	54	0.017		0.000		0.193
5	0.545	61	0.009	A	0.008	A	0.016
6	0.521	69	-C.CCO	P	0.008	P	-0.000
7	0.505	74	-0.000	P	0.007	P	-0.000
8	0.384	76	0.000	L	0.006	L	0.000
9	0.230	76	0.000	I	0.002	I	0.000
10	0.322	75	0.000	C	0.005	C	0.000
11	0.074	54	0.003	A	0.000	A	0.040
12	0.517	59	0.010	B	0.008	B	0.020
13	0.500	68	0.000	L	0.008	L	0.000
14	0.500	73	0.000	E	0.007	E	0.000
15	0.488	75	0.000		0.004		0.000
16	0.455	76	0.000		0.001		0.000
17	0.372	76	0.001		0.004		0.002
18	0.465	77	0.011		0.002		0.024
19	0.446	78	0.012		0.002		0.027
20	0.326	78	0.009		0.001		0.027
21	0.208	72	0.008		0.001		0.038
22	0.087	66	0.000		0.000		0.006
23	0.441	72	0.020		0.003		0.044
24	0.486	67	0.013		0.002		0.026
25	*	*	*		*		*
26	*	*	*		*		*
27	*	*	*		*		*
28	*	*	*		*		*
29	*	*	*		*		*
30	*	*	*		*		*
31	*	*	*		*		*
SUM	10.809	-	0.146	N.A.	0.108	N.A.	-
AVG	0.349	70	0.005	N.A.	0.003	N.A.	0.013
NBS ID	Q001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: BRAD FOPKIN , CARROLLTON , TEXAS 75006 SOLAR/1024-79/05
REPORT PERIOD: MAY,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	0.285	0.204	0.062	70	0.216
2	0.109	0.003	0.002	75	0.019
3	0.001	0.000	0.000	66	0.000
4	0.091	0.002	0.001	54	0.012
5	0.545	0.468	0.143	71	0.263
6	0.521	0.442	0.132	76	0.254
7	0.505	0.425	0.125	80	0.248
8	0.384	0.278	0.086	80	0.223
9	0.230	0.053	0.025	80	0.106
10	0.322	0.265	0.081	85	0.252
11	0.074	0.000	0.000	55	0.000
12	0.517	0.435	0.126	69	0.244
13	0.500	0.428	0.130	79	0.261
14	0.500	0.415	0.121	82	0.241
15	0.488	0.173	0.042	83	0.087
16	0.465	0.071	0.010	85	0.021
17	0.372	0.201	0.063	82	0.169
18	0.465	0.122	0.032	82	0.068
19	0.446	0.141	0.031	82	0.069
20	0.326	0.068	0.020	83	0.062
21	0.208	0.064	0.015	79	0.073
22	0.087	0.003	0.001	67	0.017
23	0.441	0.169	0.042	81	0.095
24	0.486	0.144	0.032	72	0.066
25	*	*	*	*	*
26	*	*	*	*	*
27	*	*	*	*	*
28	*	*	*	*	*
29	*	*	*	*	*
30	*	*	*	*	*
31	*	*	*	*	*
SUM	10.809	5.912	1.707	-	-
AVG	0.349	0.191	0.055	76	0.159
NBS ID	Q001		Q10C		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SITE: BRAD POPKIN , CARROLLTON , TEXAS 75006 SOLAR/1024-79/05
REPORT PERIOD: MAY, 1979

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.000	0.000	-0.003	91	1.000
2	0.000	0.000	-0.021	88	1.000
3	0.000	0.000	-0.021	85	1.000
4	0.000	0.000	-0.036	79	1.000
5	0.169	0.000	0.049	81	0.287
6	0.155	0.000	0.033	89	0.209
7	0.148	0.000	0.022	94	0.149
8	0.102	0.000	0.005	96	0.051
9	0.028	0.000	-0.020	94	-0.700
10	0.098	0.000	0.013	95	0.135
11	0.000	0.000	-0.049	90	1.000
12	0.146	0.000	0.020	88	0.135
13	0.159	0.000	0.032	93	0.200
14	0.146	0.000	0.016	97	0.112
15	0.047	0.000	-0.014	97	-0.305
16	0.004	0.000	-0.024	93	-5.796
17	0.066	0.000	0.003	92	0.052
18	0.005	0.000	-0.018	90	-3.709
19	0.011	0.000	-0.010	87	-0.897
20	0.004	0.000	-0.006	86	-1.510
21	0.003	0.000	-0.011	85	-3.897
22	0.000	0.000	-0.011	83	-42.646
23	0.009	0.000	-0.004	81	-0.438
24	0.007	0.000	-0.009	80	-1.277
25	*	*	*	*	*
26	*	*	*	*	*
27	*	*	*	*	*
28	*	*	*	*	*
29	*	*	*	*	*
30	*	*	*	*	*
31	*	*	*	*	*
SUM	1.689	0.000	-0.082	-	-
AVG	0.054	0.000	-0.003	89	-0.048
NBS ID	Q200	Q201	Q202		N108

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
HOT WATER SUBSYSTEM

SITE: BRAD POPKIN , CARROLLTON , TEXAS 75006 SOLAR/1024-79/05
REPORT PERIOD: MAY,1979

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR.OF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	0.000	0	0.000	0.000	0.006	0.006		0.000		60	140	0
2	0.000	0	0.000	0.000	0.005	0.005		0.000		60	140	0
3	0.000	0	0.000	0.000	0.005	0.005		0.000		60	140	0
4	0.000	0	0.000	0.000	0.006	0.006		0.000		60	140	0
5	0.000	0	0.000	0.000	0.005	0.005		0.000		60	140	0
6	0.000	0	0.000	0.000	0.005	0.005		0.000		60	140	0
7	0.000	0	0.000	0.000	0.006	0.006		0.000		60	140	0
8	0.000	0	0.000	0.000	0.006	0.006		0.000		60	140	0
9	0.000	0	0.000	0.000	0.004	0.004		0.000		60	140	0
10	0.000	0	0.000	0.000	0.004	0.004		0.000		60	140	0
11	0.000	0	0.000	0.000	0.006	0.006		0.000		60	140	0
12	0.000	0	0.000	0.000	0.006	0.006		0.000		60	140	0
13	0.000	0	0.000	0.000	0.006	0.006		0.000		60	140	0
14	0.000	0	0.000	0.000	0.005	0.005		0.000		60	140	0
15	0.000	0	0.000	0.000	0.005	0.005		0.000		60	140	0
16	0.000	0	0.000	0.000	0.005	0.005		0.000		60	140	0
17	0.001	9	0.000	0.000	0.007	0.007		0.000		66	141	2
18	0.000	0	0.011	0.001	0.005	0.005		0.011		70	141	0
19	0.000	0	0.011	0.001	0.002	0.002		0.011		70	141	0
20	0.000	0	0.009	0.000	0.003	0.003		0.009		70	141	0
21	0.000	0	0.008	0.000	0.005	0.005		0.008		70	141	0
22	0.000	0	0.000	0.000	0.005	0.005		0.000		70	141	0
23	0.000	0	0.020	0.001	0.003	0.003		0.020		70	141	0
24	0.000	0	0.013	0.001	0.002	0.002		0.013		70	141	0
25	*	*	*	*	*	*		*		*	*	*
26	*	*	*	*	*	*		*		*	*	*
27	*	*	*	*	*	*		*		*	*	*
28	*	*	*	*	*	*		*		*	*	*
29	*	*	*	*	*	*		*		*	*	*
30	*	*	*	*	*	*		*		*	*	*
31	*	*	*	*	*	*		*		*	*	*
SUM	0.001	-	0.093	0.007	0.150	0.150	N.A.	0.093	N.A.	-	-	3
AVG	0.000	9	0.003	0.000	0.005	0.005	N.A.	0.003	N.A.	63	140	0
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: BRAD POPKIN , CARROLLTON , TEXAS 75006 SOLAR/1024-79/05
REPORT PERIOD: MAY, 1979

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.000	0	0.000	0.000	0.000	0.000	N	-0.000	N	71	66
2	0.000	0	0.000	0.000	0.000	0.000	O	-0.000	O	71	71
3	0.000	0	0.000	0.000	0.000	0.000	T	0.000	T	71	66
4	0.160	11	0.017	0.007	0.143	0.143		0.011		66	54
5	0.094	9	0.009	0.004	0.085	0.085	A	0.005	A	68	61
6	-0.000	0	-0.000	0.000	0.000	0.000	P	-0.000	P	71	69
7	-0.000	0	-0.000	0.000	0.000	0.000	P	-0.000	P	73	74
8	0.000	0	0.000	0.000	0.000	0.000	L	-0.000	L	75	76
9	0.000	0	0.000	0.000	0.000	0.000	I	-0.000	I	75	76
10	0.000	0	0.000	0.000	0.000	0.000	C	-0.000	C	77	75
11	0.022	13	0.003	0.001	0.019	0.019	A	0.002	A	68	54
12	0.090	11	0.010	0.004	0.080	0.080	B	0.006	B	68	59
13	0.000	0	0.000	0.000	0.000	0.000	L	-0.000	L	70	68
14	0.000	0	0.000	0.000	0.000	0.000	E	-0.000	E	73	73
15	0.000	0	0.000	0.000	0.000	0.000		-0.000		74	75
16	0.000	0	0.000	0.000	0.000	0.000		-0.000		75	76
17	0.003	29	0.001	0.001	0.002	0.002		0.000		76	76
18	0.000	0	0.000	0.000	0.000	0.000		-0.000		76	77
19	0.001	100	0.001	0.001	0.000	0.000		-0.000		78	78
20	0.000	0	0.000	0.000	0.000	0.000		-0.000		78	78
21	0.000	0	0.000	0.000	0.000	0.000		-0.000		76	72
22	0.000	0	0.000	0.000	0.000	0.000		-0.000		74	66
23	0.000	0	0.000	0.000	0.000	0.000		-0.000		74	72
24	0.000	0	0.000	0.000	0.000	0.000		-0.000		73	67
25	*	*	*	*	*	*		*		*	*
26	*	*	*	*	*	*		*		*	*
27	*	*	*	*	*	*		*		*	*
28	*	*	*	*	*	*		*		*	*
29	*	*	*	*	*	*		*		*	*
30	*	*	*	*	*	*		*		*	*
31	*	*	*	*	*	*		*		*	*
SUM	0.477	-	0.053	0.022	0.425	0.425	N.A.	0.031	N.A.	-	-
AVG	0.015	11	0.002	0.001	0.014	0.014	N.A.	0.001	N.A.	73	70
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: BRAD POPKIN , CARROLLTON , TEXAS 75006 SOLAR/1024-79/05
REPORT PERIOD: MAY, 1979

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	1149	N	66	70	N	N	N
2	440	O	71	75	O	O	O
3	6	T	66	66	T	T	T
4	366		54	54			
5	2199	A	61	71	A	A	A
6	2101	P	69	76	P	P	P
7	2037	P	74	80	P	P	P
8	1548	L	76	80	L	L	L
9	929	I	76	80	I	I	I
10	1299	C	75	85	C	C	C
11	299	A	54	55	A	A	A
12	2083	B	59	69	B	B	B
13	2015	L	68	79	L	L	L
14	2015	E	73	82	E	E	E
15	1969		75	83			
16	1875		76	85			
17	1499		76	82			
18	1875		77	82			
19	1798		78	82			
20	1313		78	83			
21	839		72	79			
22	353		66	67			
23	1779		72	81			
24	1958		67	72			
25	*		*	*			
26	*		*	*			
27	*		*	*			
28	*		*	*			
29	*		*	*			
30	*		*	*			
31	*		*	*			
SUM	43584	N.A.	-	-	-	-	-
AVG	1406	N.A.	70	76	N.A.	N.A.	N.A.
NBS ID	Q001		N113			N115	N114

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